Northeastern Forest Experiment Station

Upper Darby, Pa.

BI-MONTHLY REPORT ON

FOREST INFLUENCES AND FLOOD CONTROL SURVEYS

August 1, 1950

FOREST INFLUENCES

DELAWARE BASIN RESEARCH CENTER

by I. C. Reigher

Delaware-Lehigh Experimental Forest

Rainfall through May and June was somewhat less than last year, but was better distributed. The more even distribution is reflected in groundwater levels, this year's level being nearly constant during the 2-month period.

	1949 (Inches)	1950 (Inches)
Rainfall		
May	7.24	4.36
June	1.02	3.19
	(Feet above sea level)	
Groundwater		
May (average)	1891.5	1887.5
June (average)	1886.3	1887.6

Streamflow from the beginning of the hydrologic year (October 1) to the end of May was somewhat less than that of the same period last year. However, with the higher groundwater level and the considerably higher rainfall this June we expect this deficiency to be made up by the end of June. A preview of the rainfall picture for July indicates a further gain in streamflow over the previous year; almost 5 inches of rain fell during the first 16 days of July. All in all, moisture conditions have been very good so far this summer.

Pocono Experimental Forest

A rating curve is being developed for the weir on the gaged watershed area; so far, the curve is reliable only for the lower flows. Thus, we have been able to compute monthly streamflow for those months having flows in the lower range. Additional observations are needed during periods of high water to complete the rating curve and streamflow computations for the early spring months.

A weather station has been installed adjacent to the office. It includes a recording hygrothermograph and maximum-and-minimum thermometers.

Rainfall, measured by three recording gages, is still lagging behind that at Dilldown in total since the beginning of the hydrologic year. However, most of this deficiency is the result of low rainfall during the earlier part of the year. Records in future years will show whether or not this is a general pattern.

Interception Studies

During the period studies were begun to determine rainfall interception by scrub oak and the swamp type at Dilldown. Throughfall is being measured by three trough-type collectors placed under the vegetation at each site. A similar trough located in an adjacent open area measures gross rainfall. Rainfall caught by each trough is piped to a sealed collecting can from which it is measured after each storm. Two installations have been prepared in scrub oak and one in the swamp.

Gross interception is the difference between gross rainfall and throughfall. Part of this intercepted rainfall, however, reaches the ground in the form of stemflow. Net interception, that part of rainfall which evaporates without reaching the soil, is gross interception minus stemflow. The latter factor is being determined by methods similar to those used in chaparrel at the San Dimas Experimental Forest. A lead collar is fastened to each small stem within the area being studied. Each collar is drained with the water passing through a hose to a manifold which collects the stemflow from five or six stems and thence to a sealed collecting can from which it is measured after each storm.

A similar study will be set up in the near future at the Pocono Experimental Forest.

Soil-Moisture Studies

Bethlahmy completed revisions and improvements on the alinement chart used to simplify computations of soil moisture from resistance

readings of the Colman instruments. This chart and accompanying instructions, now being reviewed for publication, greatly reduces the time and tedium involved in these calculations. In an effort to improve the calibration of the Colman units now in use at Dilldown, a large number of soil samples have been taken in the field to be correlated with resistance readings taken simultaneously.

Rock content of the soils at Dilldown, a most important factor in the water storage capability of these soils, has been under further study. Rock content is determined by actually measuring the amount of rock, by horizons, removed from the soil in digging a soil pit. Variation is great within short distances, but it is hoped that a reliable estimate can be determined.

Schoharie Watershed-Reservoir Studies

Analysis of the sedimentation survey at Schoharie Reservoir, one of the New York City water supply reservoirs, has been completed along with related studies made on the watershed.

During the course of the field work on the sedimentation survey it became more and more evident that sediment depths were shallow throughout most of the reservoir. The excessive deposits noted prior to the survey were located in the vicinity of the intake chamber to the aqueduct. As it turned out, nearly all of the excessive deposits were localized in this small area; they were caused by a small "temporary" dam constructed before the completion of Gilboa Dam 25 years ago. Its purpose was to divert the flow of Schoharie Creek into the aqueduct until the completion of the permanent dam. However, it had never been removed and by now the deposits associated with it have become troublesome, particularly during low water periods. At these times the channel to the intake is partially blocked and water flowing into the aqueduct becomes highly turbid. Furthermore, these deposits have raised the level of the dead storage pool below the intake, effectively trapping a certain amount of water which otherwise could be used.

Final computations confirmed the fact that sedimentation had not been serious. The original reservoir capacity of 63,821 acre-feet had been reduced to 62,702 acre-feet by 1,119 acre-feet of sediment. Thus, in 24 years, the total capacity of the reservoir has been reduced only 1 to 0.75 percent, or 0.073 percent per year. At this rate the reservoir would not be completely filled with sediment for some 1300 years. However, long before that time, the silt level would have reached the tunnel intake, thus making the removal of water impossible or very difficult.

In addition to the amount of sediment trapped in the reservoir, other sediments have entered the reservoir and were carried away by the effluent through the aqueduct. Based on daily turbidity and discharge

measurements of the effluent, it is roughly estimated that this additional amount is not over 10 acre-feet per year. Using this figure of 10 acre-feet per year, or 240 acre-feet for the 24-year period since the completion of the dam, the total amount of eroded material would be 1,369 acre-feet.

Schoharie watershed, the catchment area for Schoharie Reservoir, is about 200,000 acres in extent. Assuming that each acre eroded equally, and using the above figure for the total amount of eroded material, then the erosion from the watershed surface amounts to only 0.082 inches for the 24-year period, (1369 x 12/200,000), or 0.0034 inches per year. This is not a serious amount of erosion, and furthermore, it is reasonable to assume that the bulk of the sediment was removed from relatively small source areas having a much higher rate of erosion than this average figure.

Land-Use Survey

Concurrently with the sedimentation survey, the Soil Conservation Service made a reconnaissance survey of the land conditions in Schoharie watershed. This survey was made by stereoscopic study of aerial photographs. Information taken from existing soil surveys and a general knowledge of the locality aided and supplemented the interpretation. No mapping was done in the field. Land use, slope, soil, and erosion were classified by the survey.

It was found that about 55 percent of the land is covered with forest, and about 43.5 percent is in grass. Slightly more than 1 percent is plowed in any one year and a few small villages occupy the remaining small area.

Steep slopes predominate on the watershed; over 60 percent of the area is on slopes steeper than 20 percent. Less than 5 percent is on land with so little slope that it has no erosion hazard.

Table 1 is a breakdown by percent of watershed area into land use groups, slope classes, and erosion classes.

It is notable that the area of severe erosion is very small. In general, the land use survey indicates that erosion is not serious from land surface. A computation of soil loss from sloping land estimates that about 1000 acre-inches of soil is lost annually, amounting to about 2000 acre-feet for the 24-year period. This is somewhat higher than the previous estimate but the divergence is not so great as to invalidate either figure.

Table 1.--Extent of erosion in Schoharie watershed, by percentage of total watershed area (314 square miles, 200,960 acres)

Degree of erosion	Nearly level	Sloping	Steep	Total
Clean cultivated:				
Slight (normal)	0.40	0.08	0.003	0.48
Moderate	0	0.47	0.08	0.55
Severe	0	0	0	0
	0.40	0.55	0.08	1.03
Urban:				
Slight	0.14	0	0	0.14
Moderate	0	0.13	0.006	0.14
Severe	0	0	0.005	0
	0.14	0.13	0.01	0.28
Grassland:				
Slight	3.22	1.72	1.22	6.16
Moderate	0	21.56	15.67	37.23
Severe	0	0.14	0.06	0.20
	3.22	23.42	16.95	43.59
Woodland:				
Slight	0.87	7.66	38.06	46.59
Moderate	0	3.39	4.92	8.31
Severe	0	0	0.19	0.19
	0.87	11.05	43.17	55.09
All conditions:				
Slight	4.63	9.46	39.28	53.37
Moderate	0	25.55	20.68	46.23
Severe	0	0.14	0.25	0.39
	4.63	35.15	60.21	99.99

Table 2.--Summary of Schoharie watershed surveys

Period	Acre-feet	Acre-inches	Inches depth from 200,960-acre watershed	Cubic yards per square mile
Reservoir deposits - from sedimentation survey				
24-year period	1119	13,428	0.067	5749
Per year	46.6	559.5	0.0028	239.6
Reservoir deposits plus estimated silt discharge				
24-year period	1369	16,428	0.082	7034
Per year	56.6	679.2	0.0034	293.1
Erosion from land surface - from land-use survey				
24-year period	2000	24,000	0.12	10,276
Per year	83.3	1,000	0.005	428.2

To finish the job - to examine other likely sources of sediment and to learn as much as possible about the condition of the watershed - it was necessary to undertake several supplementary studies. Accordingly, Bethlahmy and Reigner spent a week on the watershed examining road banks, stream banks, the reservoir shore, and logging areas.

Road Banks within Schoharie watershed were examined for eroding conditions by a sampling type of survey. Roads were stratified according to size and condition of road as described on the base maps. Total lineal extent of each class was measured on the base map. In the field small sections, randomly selected within each class, were examined carefully for erosion. Eroded area observed was later applied to the total lineal extent of each road class.

It was found that the roads were in remarkably good condition. Of the 425 miles of road, it is estimated that 104 acres of associated land surface (bank surface, road surface, and shoulder surface) is eroding moderately. Three acres are eroding severely. The severely eroding surface and 85 acres of the moderately eroding land is road surface of dirt roads. In country as steep as Schoharie watershed, it is unlikely that this condition could be much improved except by surfacing the dirt roads.

Stream Banks were examined for erosion in a similar manner. Some moderate erosion was found but it is estimated that an aggregate of only 13 acres of moderately eroding surface is associated with the 410 miles of streams in the watershed.

The Reservoir Shore showed much evidence of erosion during the sedimentation survey. Accordingly, as a part of the supplementary surveys, eroding areas above the flow line were rapidly sketched on a large map of the reservoir. These areas were later scaled and totaled.

Although there is considerable erosion concentrated within a relatively small area, the eroding surface is also minor when applied to a watershed. Slightly less than 4 acres of moderately eroding surface was observed; about 2 acres were eroding severely. It is impossible to estimate the volume of material that might have been eroded in the past 24 years, but from the area involved it could not have been an important part of the sediments found.

Erosion Caused by Logging

During the course of the road-bank and stream-bank studies, several logging operations were visisted when encountered en route. Since these observations were not on a sampling basis, no attempt has been made to estimate the relative importance of this type of erosion. However, the following comments may prove useful for further consideration.

Forest stands in the area are generally all-aged. Selective logging with a rather light cut per acre is the general practice. Thus, there is little erosion due to the removal of the vegetative cover. Skid trails, usually running straight down the slope, are the main source of eroding material.

Skid trails resulting from horse logging, usually on the smaller operations, appear to be less serious than those on which tractors were used. Most of the operations visited did not seem to be serious sources of eroded material. The one exception, however, presented an outstanding example of the damage sometimes caused by logging.

The site was on a steep mountainside and covered a large area with a light cut per acre. Skidding was done during the past winter and spring by tractor, with skid trails generally running perpendicular to the contours. No attempt was made to avoid water courses and as a result, flowing water got into the tractor ruts. Erosion was accelerated by the running water until the ruts are now three to four feet deep in places. These eroding ruts appear to have taken the place of original stream channels. Thus, a source of erosion and sedimentation has been developed which may take a number of years to be corrected by nature, and, in addition, it is likely that the water relations for this area have been altered.

Conclusions

Except for one localized area, sedimentation in the Schoharie Reservoir has not been important. As a corollary to this, erosion from the catchment area has not been serious, the land-use survey and supplemental studies giving further weight to this conclusion. Despite this conclusion, however, analysis of the land-use survey points out land misuse.

Erosion is much more widespread on grass land than on comparable forest land. In both sloping and steep land categories, the preponderance of forest land is classed as having slight (normal) erosion. The majority of the grass land, on the other hand, is suffering moderate erosion. The difference is highly significant. Increased erosion on grass land may be attributed to the following causes:

1. Land too steep or soils too erodible to be in grass land.
2. Poor grazing practices.

Adjustments of land use and better grazing control would result in better water relations and increased income to the landowners, in addition to still less sedimentation in the reservoir. Improvement should also be made in the layout and care of skid trails in logging.

The information gained from these studies will serve as a guide for future studies and will be highly valuable in gaging the condition of other, similar watersheds. Schoharie watershed is adjacent to the headwaters of the Delaware Basin and is comparable to the watersheds which will shortly be used for additional water supply.

Personnel

John J. Coughlin and Norton M. Knecht, Conservation students at Lehigh University, were added to the staff for the summer months. Both men are assisting in the soils studies.

MOUNTAIN STATE RESEARCH CENTER

By Sidney Weitzman

Activities

The activities during this period were devoted primarily to installing five weirs and five gauge houses on the Fernow Experimental Forest. The major construction job has been completed. Installations of instruments remain to be done. Though the construction job was handicapped by rainfall and lack of roads, the major job was completed on schedule. It rained 22 days in May and 18 days in June. Three-quarters of a mile of road was constructed, three bridges were constructed, and two repaired in order to move equipment and material to the sites.

Flash Flood

The Mountain State Research Center prepared a report on the flash flood of June 24-25, 1950, in Central West Virginia. The following are a few highlights from the report.

Eight counties in north-central West Virginia in three separate drainage areas were directly affected by the flood. The three drainages are Middle Island Creek, Little Kanawha River, and Monongahela River. The flood area is characterized by long, steep slopes and narrow valleys. Flood plains are comparatively narrow or lacking and the valley walls follow the crooked streams very closely. Farms, towns, and villages are concentrated in the narrow flood plains and flood terraces. Soils are shallow. The area has been largely cleared of its forest cover. The area remaining in forest land is made up of farm woodlands and is a definite land-use problem. These woodlands have been overcut and high-graded. In addition, the woods were repeatedly burned.

Agriculture is handicapped in this area because of the rough and hilly nature of the land. Cultivated crops are raised primarily on the small bottom-land fields. Approximately 15 percent of the area is devoted to cultivated crops.

Today, approximately 50 percent of the area is in pasture land. Much of it is on slopes too steep or on soils too eroded and abused to remain in open land. Approximately 40 percent of the pasture land has been classified as Class VII land and should revert to woods from the standpoint of good land-use management as well as sound watershed management.

The area was subjected to a torrential downpour during the night of June 24-25. Records currently available indicate that as much as 14 inches of rainfall fell in 3 to 8 hours in isolated areas.

The flash flood rose rapidly during the night to unprecedented peaks. The flood stages in most streams exceeded all previous records including the great flood of 1888.

The rapid rises caught residents asleep in their homes and unprepared to cope with the flood. This combination of rapid rises coming during the night is largely responsible for the high loss of life and contributed to the large property damage. There was no time to salvage personal belongings or do any rescue work. Thirty persons were drowned. Preliminary estimates have placed damages as high as 50 million dollars. Some of the smaller streams crested at record peaks within a few hours after the rains began. Even the larger streams were back within their banks in 24 hours.

A detailed hydrologic study is necessary before any land-use remedial measures can be recommended. Such a study may well indicate that this area with its steep hillsides and narrow flood plains is subject to severe floods, especially following a torrential downpour. However, that does not detract from the fact that several remedial measures seem advisable from the standpoint of good land-use management as well as watershed management. These are:

1. Extension of the forest area, especially on the steep pasture areas that have not received very good management or treatment and that can never support a very profitable pasture. These critical areas show signs of severe sheet erosion and are now being destroyed by slips.

2. Protection and management of the existing and proposed forest areas from fire and poor cutting practices.

3. Elimination of woodland grazing. Very few of the woodlands have been fenced. The cattle wander through the woodlands to supplement their feed.

4. Extension of soil conservation measures such as contour plowing, terraces, and diversion ditches on those areas that are to remain in open land.

5. A zoning law to keep industries, towns, and dwellings from further encroaching on the flood plain.

Personnel

Lem Miller, hydrologist, who was assigned to the construction of the gauging stations, has returned to Upper Darby.

George R. Trimble, Jr., has been transferred to the Mountain State Research Center from the Division of Flood Control Surveys in Upper Darby. He will be project leader for the influence studies.

Visitors

Dr. Harper spent July 3 on the Fernow checking the new installations.

FLOOD CONTROL SURVEYS

By Arthur Bevan

GENERAL

Flash floods in north-central West Virginia occurred on June 24-25. Flood stages in the streams affected were the highest of record, exceeding those of 1888. The streams rose and fell with unprecedented rapidity. Happening in the middle of the night, there were no warnings of disaster and 30 lives were lost. Preliminary estimates (probably high) place the damages at $50,000,000. A preliminary report based on a reconnaissance survey has been prepared and submitted to Washington.

A comprehensive survey, similar to that being initiated for the Arkansas, White, and Red Rivers, is proposed for the New England Rivers, Hudson River (N.Y.), and Great Lakes-St. Lawrence drainages in New York and Vermont. Data and material covering Forest Service participation in this survey were prepared for the WO..

A quick review by Station personnel was made of a draft manuscript on the Connecticut River watershed prepared by the staff of the President's Water Resources Policy Commission. It was our opinion that the report overemphasized the hydro-power problem. While this is a highly controversial and politically hot subject, it is probably not the most important problem requiring policy determination at the National level.

FLOOD-CONTROL SURVEY ACTIVITIES

Completion of the Connecticut report was given priority. A final draft was submitted to the WO. for review. Leon Lassen spent 2 days with us and was most helpful in putting the report in final shape for submission to Washington.

All data and material have been collected and compiled on the Merrimack report and substantial progress made in writing the preliminary draft.

The PE report on the Salt River (Ky.) has been completed and is in process of clearance with Federal agencies requesting an opportunity to review. A work outline has been completed ready for submission with the PE report.

Work on the Delaware report has been completed and S.C.S. is preparing the final draft.

We have completed the revision of the woodland phases of the Roanoke report and forwarded this material to SCS Spartanburg, South Carolina.

STATUS OF SURVEYS

Connecticut River.--Report completed and being processed--ready for submission to Washington.

Merrimack River.--Preliminary draft of revised report in progress--for review by regional and state agencies.

Allegheny River.--Program for the entire watershed and the total costs have been completed. Hydrologic analysis about 85 percent complete.

Monongahela, Upper Susquehanna Rivers.--No further progress.

Salt River.--Damage appraisal surveys about 80 percent complete.

PRELIMINARY EXAMINATIONS

PE on the Salt River completed and approved by SCS Spartanburg and Central States Station. Being reviewed by Regional offices of Federal agencies requesting review before submission. Survey work outline completed.

COOPERATION WITH SOIL CONSERVATION SERVICE

Delaware River.--Reviews completed. Final draft being prepared by SCS, Upper Darby.

Youghiogheny River.--Revision of report started.

Roanoke River.--Revision of woodland phases of report completed and forwarded to Spartanburg.

Lower Susquehanna.--Work started on PE report.

MEETINGS

A meeting of the Vermont Development Commission was attended in June to discuss the Connecticut Report. In addition to the members of the Commission, which included many State Officials, the Vermont Forest Service was represented. The purpose and scope of the flood-control program was discussed.

A meeting of the President's Water Policy Commission was held at Springfield, Mass., on July 25. All members of the Commission were present. The meeting was well attended, there being about 175 persons present. Most of the testimony dealt with the hydroelectric power problem in New York and New England. Water-supply, flood-control, and land-use problems were hardly touched upon. All witnesses except cooperative rural electric organizations were opposed to Federal participation in projects beyond the planning stage. State and interstate action through compacts was recommended. Federal participation, if any, should be on the basis similar to that on highways. There were many recommendations for a comprehensive plan for the area.